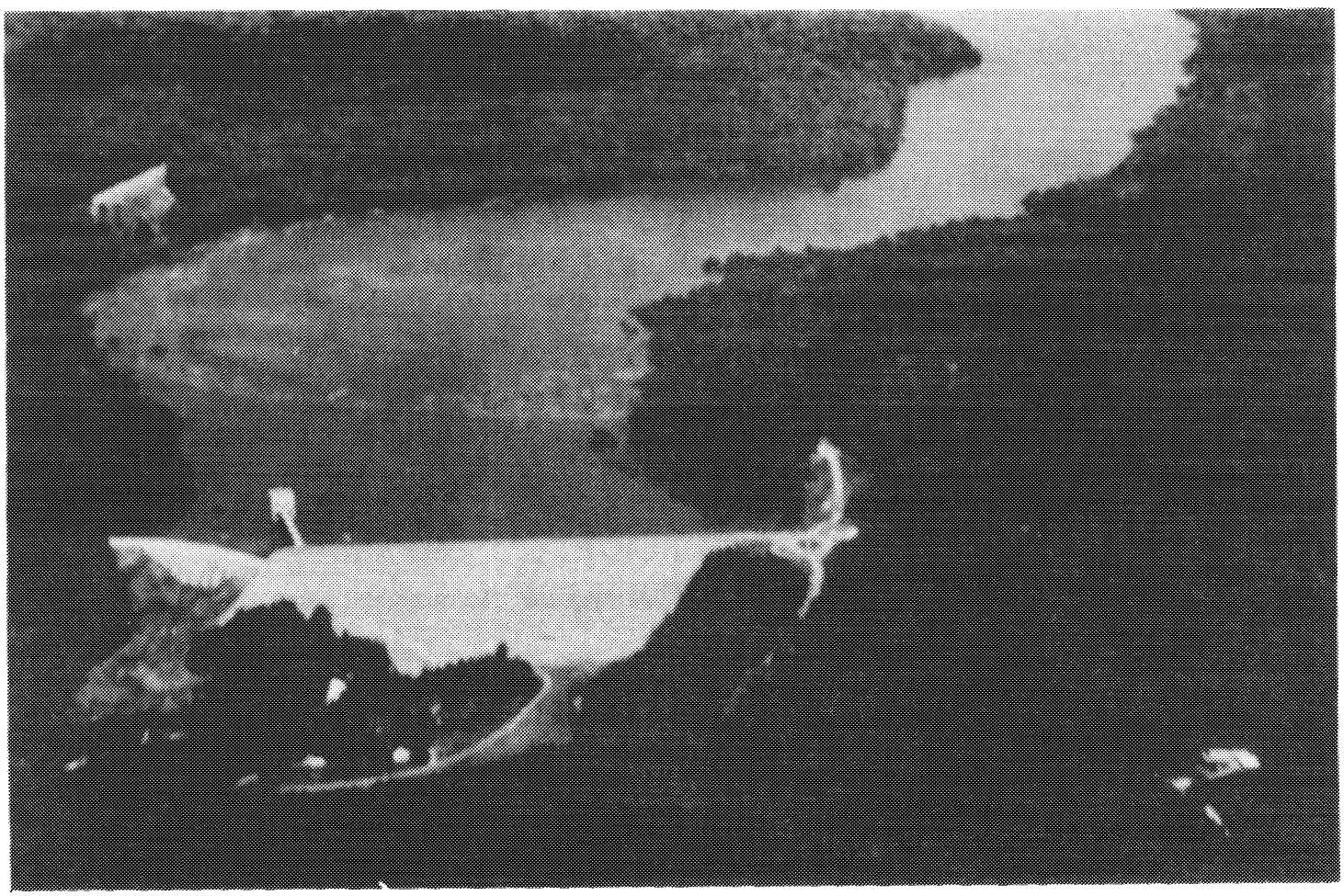
Drought Contingency Plan

US Army Corps
of Engineers
New England Division

SEPTEMBER 1993

Knightville Dam, Huntington, Massachusetts



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In the 1990's New England Division started updating drought contingency plans that were previously developed in the 1980's.

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13. ABSTRACT *(Maximum 200 words)*

This drought contingency plan includes a description of existing water supply conditions, the possibility of reallocation of reservoir storage within specified limits, evaluation of water quality, discussion of impacts on other project purposes, and the effects on the environment.

Due to a variety of reasons, mainly topography and distance from potential beneficiaries, the Commonwealth of Massachusetts Executive Office of Environmental Affairs are not interested in sponsoring emergency storage at the project. Therefore, drought contingency storage for emergency water supply purposes at Knightville Dam is not implementable.

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SUMMARY

In the 1990's NED started updating drought contingency plans that were previously developed in the 1980's for some of our reservoirs. One of the requirements to updating the drought contingency plans, to make them fully implementable, is state sponsorship. If there is no state sponsorship then a nonfeasible plan will be published for that particular project.

In letter, dated August 11, 1992 (copy attached), the Commonwealth of Massachusetts Executive Office of Environmental Affairs, Department of Environmental Protection (DEP) withdrew its support as a sponsor for the drought contingency plan at Knightville Dam. The DEP indicated for a variety of reasons, mainly topography and distance from potential beneficiaries, they currently are not interested in sponsoring emergency storage at the project. Therefore, the Massachusetts DEP is not interested in entering into a contract with the Corps.

Since there is no state sponsorship for drought storage at Knightville Dam, the drought contingency plan previously developed is presented herein for informational purposes only. If, at some future date, the state were to indicate an interest, drought contingency storage will be re-evaluated and this report updated as necessary to respond to the state request.

DROUGHT CONTINGENCY STORAGE FOR EMERGENCY WATER SUPPLY PURPOSES AT KNIGHTVILLE DAM IS NOT IMPLEMENTABLE

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

August 11, 1992

Mr. Richard D. Reardon
Director of Engineering
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Reardon:

I am responding to your letter of June 2, 1992 regarding the Commonwealth's interest in the development of drought storage capacity at several Corps dams. After having reviewed the water supply situation in the communities proximate to the reservoirs, the Department has not identified a user for the water for the purposes described in your letter. Based on this determination, the Department will not enter into a contract with the Corps at this time.

I thank you for the offer of assistance and look forward to working with your office on projects of mutual interest in the future.

Sincerely,

Arleen O'Donnell
Assistant Commissioner

cc: Charles Joyce

One Winter Street • Boston, Massachusetts 02108 • FAX (617) 556-1049 • Telephone (617) 292-5500

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO ATTENTION OF

June 2, 1992

Engineering - Water Control

Ms. Arleen O'Donnell
Assistant Commissioner, Resource Protection
Department of Environmental Protection
One Winter Street
Boston, Massachusetts 02108

Dear Ms. O'Donnell:

The New England Division, Corps of Engineers, is currently updating previously developed plans for drought contingency storage at some of our reservoirs in Massachusetts. We have identified these projects as having merit in providing a source of water supply during drought emergency conditions. Each reservoir has been initially screened by this office and an appropriate plan developed. Listed below are names and locations of each candidate reservoir in Massachusetts. Attachments 1 through 7 present fact sheets with pertinent information for each project, and attachments 8 through 10 show locations. In addition, the study for Tully Lake in Royalston, Massachusetts, is nearing completion, and is in the process of being finalized with the Department of Environmental Protection. Our mutual efforts were unable to identify a community or State agency that would be interested in emergency storage at Tully Lake; therefore, the Department of Environmental Protection is not interested in entering into a contract with the Corps.

Name	Location
East Brimfield Lake*	Sturbridge
Westville Lake	Sturbridge
West Hill Dam	Uxbridge
Littleville Dam	Huntington
Knightville Dam	Huntington
Hodges Village Dam	Oxford
Buffumville Dam	Charlton

* Currently scheduled for study in fiscal year 1993

The Drought Contingency Plan (DCP) presents a basic planning aid assessment of Corps projects as a potential emergency short term water supply source during a State-declared drought emergency, with each DCP identifying the following:

a. Hydrologic assessment of drought storage potential.

b. Standard operating procedure for drought storage and releases.

c. State sponsor for the plan and potential beneficiary.

d. Draft Drought Emergency Water Contract identifying conditions of the emergency water storage, withdrawal, and cost.

Previously, we were requesting interest by the Commonwealth of Massachusetts on a project-by-project basis. In an effort to reassess and update the entire drought contingency program, we are requesting your agency forward a letter to this office expressing interest in participation in the program for all candidate reservoirs within the Commonwealth. You are, therefore, requested to review the attached list of projects, solicit the surrounding towns for interest, determine your interest in all or some of them and provide us with a prioritized list. Your letter should identify the appropriate State agency to act as sponsor for the DCP and signatory to the contract, potential water supply user, and method of transporting water (i.e., reservoir releases, trucking, etc.) for each project. When determining a user, surface water treatment facilities should be available. If treatment facilities are not available within a specific region, you should carefully consider if sponsoring a particular project is feasible. The Commonwealth would incur no costs for the preparation of the DCP or for the water itself until such time as the Governor declared a drought emergency in the area in question and a decision made to begin emergency storage at the particular dam.

If you have any questions regarding this request or would like to set up a meeting to discuss the possibilities of

drought contingency storage, please contact Mr. Steven Simmer of my staff at 617-647-8524.

Sincerely,

Richard D. Reardon
Director of Engineering

Attachments

CF:
Mr. Simmer - 115N
Mr. Joyce - 114S
Reading File
Engr Dir Files - 112S

CONNECTICUT RIVER BASIN
WESTFIELD RIVER WATERSHED

DROUGHT CONTINGENCY STORAGE PLAN
KNIGHTVILLE DAM

1987

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

SYLLABUS

This report is a compilation of basic information on the Corps of Engineers Knightville Dam to aid the assessment of the project as an emergency domestic water supply source. Included are sections on project description, operating procedure, available storage capacity, water quality, water supply systems in the region and potential impacts. It was not within the scope of the study to perform detailed analyses but mainly to address the emergency potential of the site and identify and discuss a variety of concerns to be considered in weighing Knightville versus any other available sources of emergency supply. A review of all current applicable environmental, riparian or other laws would be required at the time of any decision to pursue drought contingency storage at the project. The Corps of Engineers would not consider drought storage activities at Knightville without an official request from the Commonwealth of Massachusetts.

Knightville Dam is located on the Westfield River in central Massachusetts in a region where 13 public water supply systems service 174,000 people. Knightville Dam could seasonally provide about 1975 AC-FT (643 MG) of emergency water supply storage. Water quality at Knightville is good. Storing water at the project may slightly degrade the existing water quality, however with filtration and disinfection it would be acceptable for public water supply. A monitoring program should be implemented to measure levels of turbidity, coliform bacteria and heavy metals if the stored water is to be used as a public drinking water supply.

Drought contingency storage at Knightville during the growing season would impact existing vegetation on up to 145 acres in the reservoir area with accompanying impacts on non-water based recreation facilities and activities at the project, also drought contingency storage and minimum releases at this normally "dry-bed" reservoir where inflow generally equals outflow, could produce added downstream environmental impacts.

DROUGHT CONTINGENCY STORAGE PLAN
KNIGHTVILLE LAKE

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DROUGHT CONTINGENCY STORAGE PLAN

KNIGHTVILLE DAM

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a posssible drought contingency plan of operation for Knightville Dam that would be responsive to public needs during drought periods and identify possible modifications to project regulation within current administration and legislative constraints. The scope of this drought contingency plan includes information on current water supplies in the region, the possibility of reallocation of reservoir storage within specified limits, description of existing water supply conditions, water quality evaluation, discussion of impacts on other project purposes, and summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basinwide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Knightville Dam and Reservoir was authorized by the Flood Control Act of 28 June 1983, Public Law 761, 75th Congress. Construction of Knightville Dam was initiated in September 1939 and completed in December 1941.

4. PROJECT DESCRIPTION

Knightville Dam is a flood control project located in Huntington, Massachusetts on the Westfield River in the Connecticut River Basin. A map of the Connecticut River Basin is shown on plate 1 and a Westfield River watershed map is shown on plate 2.

At spillway crest (elevation 610 feet-NGVD), Knightville Dam has a storage capacity of 49,000 acre-feet, equivalent to 5.6 inches of runoff from the contributing drainage area of 162 square miles. An area-capacity table is shown on plate 3.

The physical components of Knightville Dam consist of; a hydraulic earthfill dam, a rock chute-type spillway with concrete weir, outlet work, and recreational facilities. The outlet works, located in the dam's right

abutment, consist of a 280 foot long intake channel, a 605 foot long, 16 foot diameter flood control tunnel, three 6.0-foot wide by 12-foot high broom gates and the control tower.

A summary of pertinent data for Knightville Dam is listed on plate 4.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. No minimum pool is maintained at Knightville during the nonfreezing summer season and it is therefore termed a "dry bed" flood control reservoir. Normal gate setting during the nonfreezing season are 2'-0'-2'. A winter pool is maintained at Knightville at a stage between 15 and 20 feet to prevent freezing of the flood control gates.

b. Flood Periods. Knightville Dam is operated in concert with Littleville Lake to reduce flooding along the Westfield River and with other projects within the Connecticut River Basin to reduce flooding further downstream along the Connecticut River.

Operations for floods may be considered in three phases: phase I - appraisal of storm and river conditions during development of a flood, phase II - flow regulation and storage of flood runoff at the reservoir, and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in Appendix H of the Master Water Control Manual for the Connecticut River basin.

c. Regulating Constraints.

(1) Minimum Releases. A minimum release of about 20 to 30 cfs is maintained during periods of flood regulation in order to sustain downstream fish life. During non-flood periods, the outflow generally equals inflow.

(2) Maximum Releases. The maximum nondamaging discharge channel capacity immediately downstream of Knightville is about 4,500 cfs. Releases at or near this rate can be expected whenever peak inflows have exceeded this value and climatologic and hydrologic conditions permit.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 28 New England Division flood control dams, and continually monitors rainfall, snowcover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective

Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General: The area of concern is a portion of the western region of Massachusetts in the vicinity of Knightville Dam. Table 1 contains information about public water suppliers in this area based on information provided by the Massachusetts Department of Environmental Management, Division of Water Resources. Of the 17 communities viewed as potential users of water from Knightville Dam during drought conditions, 12 of the communities are served by public water supply systems. No data is available for those areas dependent on private individual water systems.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Knightville Dam that could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study addresses only modifications in the operational procedures at Knightville Dam in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. Public Water Suppliers. As noted in Table 1, the data given for each water supplier includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1984, estimated safe yield of the source, and any further information available on the source of supply. An analysis of the adequacy of existing sources during drought conditions has not been performed. The information is shown to present a summary of the existing water supply conditions for the western Massachusetts area.

d. Population Projections. Population projections for communities in the study area are given in Table 2 to show population trends for each community potentially affected by a prolonged dry period. The population projections were provided by the Department of Environmental Management, but were developed by regional planning agencies encompassing communities in the vicinity of Knightville Dam. This information indicates areas of potential future growth in the western Massachusetts area.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at the Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 direct field offices to determine the short-

Table 1
Major Water Suppliers - Western Massachusetts

Company or Agency	Town Served	Est. Population Served -- 1980	Source of Supply (SW/GW)	1984 Demand Avg. Day (MGD)	1984 Demand Max. Day (MGD)	Safe Yield (MGD)	Comments
	Becket		No central supply				
Blanford Water Dept.	Blandford	864	SW	0.08	0.16	0.50	Long Pond
Chester Water Dept.	Chester	650	SW	0.06	0.08	0.20	Austin Br. Res, Horn Pd.
	Chesterfield		No central supply				
Easthampton Board of Public Works	Easthampton	15,424	GW	3.46	5.19	6.50	Three wells, one wellfield
Holyoke Water Dept.	Holyoke	44,311	SW/GW	9.22	12.71	20.90	7 reservoirs, one well
Pequot Water Co.	Holyoke	213	GW	0.02	0.03	0.54	One well
Huntington Water Dept.	Huntington	1,000	SW/GW	0.09	0.14	0.29	Cold Brook Res., two wells
	Middlefield		No central supply				
	Montgomery		No central supply				
Northampton Water Dept.	Northampton	29,257	SW/GW	3.97	5.10	10.00	Three reservoirs, two wells
	Otis		No central supply				
Russell Water Dept.	Russell	1,200	SW/GW	0.31	0.34	0.35	Black Brook Res., one well
Southampton Water Dept.	Southampton	1,800	SW/GW	0.11	0.17	0.87	Manhan Res., one well
Westfield Water Dept.	Westfield	33,450	SW/GW	6.02	11.86	16.50	Granville Res., eight wells
Westhampton Water Co.	Westhampton	114	SW	0.02	0.03	0.06	Mt. Brook Res.
West Springfield Water Dept.	West Springfield	26,960	SW/GW	4.02	7.13	6.50	Bear Hole Res., four wells
Worthington Fire Dist.	Worthington	480	SW/GW	0.04	0.06	0.15	Two reservoirs, three wells

Table 2
Population Projections - Western Massachusetts

Town	Actual 1980	1985	1990	1995	2000	Percent Change 1980-2000
Becket	1,339	1,480	1,680	1,910	2,060	53.85
Blandford	1,038	1,082	1,214	1,293	1,321	27.26
Chester	1,123	1,188	1,238	1,269	1,280	13.98
Chesterfield	1,000	1,106	1,199	1,288	1,318	31.80
Easthampton	15,580	16,172	16,641	16,974	17,229	10.58
Holyoke	44.678	42,667	41,728	41,853	42,607	-4 64
Huntington	1,804	1,867	1,973	2,050	2,114	17.18
Middlefield	385	420	449	469	478	24.16
Montgomery	637	757	847	893	913	43.33
Northampton	29,286	29,755	30,529	31,353	32,388	10.59
Otis	963	1,030	1,130	1,230	1,300	34.99
Russell	1,570	1,685	1,786	1,865	1,915	21.97
Southampton	4,137	4,642	5,106	5,535	5,740	38.75
West Springfield	27,042	27,988	28,772	29,261	29,583	9.40
Westfield	36,465	39,820	42,886	45,459	47,277	29.65
Westhampton	1,137	1,296	1,431	1,514	1,550	36.32
Worthington	932	1,003	1,073	1,129	1,161	24.57
	169,116	173,958	179,682	185,345	190,234	12.49

term water supply capability of existing Corps reservoirs. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage. It has been determined that a portion of the existing storage at Knightville Dam could be utilized in an emergency, for drought contingency storage on a seasonal basis without having an impact on the project's flood control function. Emergency storage could be made available during the late spring - early summer season to a pool elevation of 520 ft-NGVD (40 ft stage). This represents a total volume of about 1975 AC-FT (643 MG), or approximately 4.0 percent of the total reservoir storage, equivalent to about 0.23 inches of runoff from the project's watershed.

Based on an all season low flow duration analysis using 76 years of flow records at the gaging station on the Westfield River immediately downstream of Knightville Dam (DA=162 Sq. Mi.), it was determined that during a 10-year frequency drought, the volume of runoff could fill the reservoir to elevation 520 ft-NGVD in: (a) a 33-day summer period with no releases made at the dam or (b) in a 77-day period while maintaining a minimum outflow of either 16.2 cfs (0.1 cfs/sq. mi.), or equal to inflow if it is less than 16.2 cfs. For this latter condition, during a 10-year frequency drought, no storage would take place for about 23 days of the period as inflows, and outflows, would be less than 16.2 cfs. A control flow of 16.2 cfs is about 25 percent larger than the natural 10-year, seven day "bench mark" low flow at Knightville Dam based on analysis of the 76 years of U.S. Geological survey streamflow records at Knightville.

During a low flow spring season the reservoir could be filled to elevation 520 ft-NGVD in about all-day period in May while continuously releasing 16.2 cfs. The stored water could be used for municipal supply with proper treatment, either by drawing directly from the reservoir or releasing the water for downstream withdrawal. Drought contingency storage vs. flow duration at Knightville Dam is shown graphically on plate 5.

c. Effect of Regulated Flows. The curtailment of flows from Knightville Dam during a drought emergency could adversely impact on the flowage rights of downstream riparian users. At this time, however, it is not possible to review all the various drought emergency situations that could occur, nor is it within the scope of this report to identify or quantify all, actual or potential, water users. In a drought emergency, the goal would be to operate in the public interest, established by weighing a range of potential impacts including; the needs and rights of known users and through consultation with responsible state officials.

9. WATER QUALITY EVALUATION

a. Water Quality Classification.

The Westfield River, including the reach above Knightville Dam, has been classified by the Massachusetts Division of Water Pollution Control as a class B cold water fishery. This is not a statement of existing water quality conditions in the river but rather reflects the water quality goals established for the Westfield River.

Class B waters are managed to achieve a high level of quality which consistently exhibit an excellent aesthetic value and provide a high quality habitat for aquatic biota, fish and wildlife. Class B waters are acceptable for public water supply after filtration and disinfection; irrigation and selected agricultural uses; swimming and other water contact recreation.

Technical requirements for class B cold water fisheries include a minimum dissolved oxygen (DO) concentration of 6 mg/l, a maximum temperature of 68 degrees Fahrenheit, pH in the range of 6.5 to 8.0 standard units or as naturally occurs, and fecal coliform bacteria counts that do not exceed a log mean of 200 per 100 ml. There shall be no substances in concentrations that produce objectionable color, odor, or turbidity or substances in concentrations that exceed the limits necessary to control eutrophication.

The waters shall be managed so as to prevent the discharge of toxic wastes in concentrations, quantities or combinations which may create a significant likelihood of an adverse impact on human health or acute or chronic toxicity to fish or wildlife.

b. Existing Water Quality.

Water quality data collected at Knightville Dam by New England Division since 1970 indicates that the waters of the project are of excellent quality, usually meeting or exceeding Massachusetts class B water quality criteria.

Indicative of the project's high water quality are the consistently high DO levels, neutral to alkaline pH levels, and generally low levels of color, turbidity and total coliform bacteria. Levels of algal nutrients are below the threshold concentrations to support algal blooms in an impoundment.

The only water quality concern identified by New England Division's water quality monitoring program was occasional elevated mercury measurements. Although most mercury determinations found less than detectable levels, measurements of up to 1.02 ug/l have been recorded

at the project. These levels exceed the maximum criteria for drinking water along with the maximum criteria set to protect sensitive aquatic organisms. However, the mercury levels at Knightville Dam appear to be of natural origin and are typical of levels found at other New England Division projects. There is no indication that aquatic life is being harmed by mercury at these sites. If the water at Knightville Dam was to be used for public water supply, the mercury levels should be monitored.

c. Water Quality Requirements for Drought Storage.

In defining the water quality requirements for drought storage, there exists two conditions that must be met. The waters must satisfy state standards for surface waters and must be of a quality suitable for the water supply users. A water which meets class B standards in Massachusetts is acceptable for public water supply after filtration and disinfection. The water quality required for industrial water supply depends on the industrial process involved. The water at Knightville Dam would always be of a quality suitable for firefighting and irrigation.

d. Effects of Drought Storage.

Water stored at Knightville Dam for emergency drought relief would be fit for use in a municipal water supply after filtration and disinfection. However, the act of storing water at Knightville Dam could cause some degradation of water quality at the project which could adversely affect its use for recreation and aquatic habitat, and severely affect the downstream aquatic life due to a reduction in streamflow.

The creation of emergency storage would flood vegetated lands and increase the hydraulic residence time at the project. With a depth of 40 feet, 145 acres of land would be inundated. The decay of organic materials on this land could result in increases in the levels of color and soluble nutrients and add undesirable taste and odor to the water. Additional nutrient enrichment may enhance the formation of algal blooms which could also add unpleasant odors and tastes.

The death of vegetation in the newly inundated areas could also loosen the soil resulting in the accelerated erosion of these soils when the pool is lowered. Much of the eroded soil would settle in the lake, but some would be discharged downstream. This increased erosion and sedimentation would not affect the suitability of the water for water supply or recreation, but will diminish the aesthetics of the area.

A 40-foot deep impoundment would probably experience temperature induced density stratification with the consequent possibilities of water quality degradation such as low dissolved oxygen levels within the hypolimnion and the discharge from the project. An increase in downstream river temperatures would also be expected.

e. Water Quality Conclusions.

Knightville Dam's excellent water quality may be degraded if emergency drought storage is formed; however, it will be adequate for public water supply following filtration with disinfection. Because of the potential for undesirable tastes and odors, a multi-media filtration system including activated carbon should be used.

No treatment should be required for the water to be suitable for use in irrigation, firefighting, groundwater recharge or selected industrial processes.

If the water at Knightville Dam were to be used for public water supply, a monitoring program should be implemented to monitor levels of turbidity, coliform bacteria and heavy metals.

10. DISCUSSION OF IMPACTS

a. General.

The following discussion of environmental impacts serves only to identify potential concerns. A more thorough investigation would be required to more accurately determine impacts to vegetation, fauna, and water quality if, and when, drought storage is proposed. It is anticipated that an environmental assessment at the time could adequately address these issues.

b. Aquatic Ecosystem.

Knightville Dam is located on the Westfield River in the Connecticut River Basin. Westfied River is classified as a Riverine-Upper Perennial-Open Water-Permanent ecological system by the U.S. Fish and Wildlife Service, National Wetlands Inventory.

No permanent pool is maintained at Knightville Dam. Instead the Westfield River is left to flow through a large valley behind the dam. The valley is covered with various species of grasses and shrubs. The sides of the valley are bordered by steep slopes which are occupied by tree species described in the "Wetlands and Upland Vegetation Section." Further upstream the river passes through forests and a few open areas.

Cold water and warm water aquatic inhabit the Westfield River. Cold water fisheries presently managed at Knightville Reservoir include rainbow (Salmo gairdneri), brown (Salmo trutta), and brook (Salvelinus fontinalis) trout. These are stocked seasonally by the Massachusetts Division of Fish and Wildlife. The trout do not appear to be spawning naturally as they are limited by the scarcity of suitable cover and

habitat and are caught as soon as they are stocked in the river. Within the reservoir area, rough fish such as creek chub (Semotilus atromaculatus), white sucker (Catostomus commersoni), and blacknose dace (Rhinichthys atratulus) are also present.

Warm water species typically inhabiting the Westfield River are yellow perch (Perca flavescens), white perch (Morone americana), brown bullhead (Ictalurus nebulosus), chain pickerel (Esox niger), as well as smallmouth bass (Micropterus dolomieui) and largemouth bass (Micropterus salmoides).

A comprehensive study of aquatic vegetation in the project area has not been conducted. However, there are currently no problems with aquatic weeds or algae blooms in the reservoir waters.

Knightville Dam is termed a "dry bed" flood control reservoir as no minimum pool is maintained during the nonfreezing season. The pool is maintained at a stage level between 15 and 20 feet during the winter season to prevent freezing of the flood control gates. Flood control activities at the dam would not be adversely affected by seasonal storage of waters, in a drought emergency to the 40-foot stage.

It has been determined that during a 10-year frequency drought, runoff could fill the reservoir to the 40 foot stage in a 33-day summer period with no releases from the dam, or in a 77-day period while maintaining an outflow of 16.2 cfs or inflow if less. The 0 cfs is cited as a reference point and would not be implemented since it would create significant water quality and fisheries impacts downstream. Restricted flows during drought storage would concentrate the existing aquatic community downstream into waters which may be experiencing low dissolved oxygen content and higher temperatures due to drought conditions and low dam releases. These conditions could reduce the carrying capacity of the water.

Inundation of an additional 145 acres of land could effect the water quality of the Westfield River (see Water Quality Evaluation Section). Decreased dissolved oxygen (DO), increased nutrient levels and decreased pH in the pool are the possible results of submersion of additional soils and vegetation. Increased nutrient levels could encourage large blooms of offensive algae which could lead to a reduction in DO levels and/or the creation of offensive tastes and odors (Bell, 1986).

Inundation could exacerbate areas of sloughing along the riverbank of the Westfield River. The high volume of spring flooding in 1987 deposited several inches to a foot of silt and clay along the valley floor and floodplain along the Westfield River. Drought storage could resuspend particulates not washed away by rain, creating unfavorable

conditions to aquatic species, vegetation, fish and other wildlife. Excessively turbid water can effect the spawning abilities of some species of fish such as bass and trout (Bell, 1986).

Soils with high organic content can cause a significant degradation of water quality (Ploskey, 1981). The low DO and low pH levels which result can effect the aquatic community. According to Bell (1986), pH's between 6.7 and 8.3 are found to contain good fish fauna. DO levels below 5 milligrams/liter (mg/l) are limiting to warm water fisheries and DO levels below 7 mg/l are limiting to cold water fish spawning areas. Warm water fisheries are tolerant to a maximum temperature of 85°F and the maximum for a sustainable cold water fisheries is 68°F (Bell, 1986). The combined effects of untolerable temperatures and low DO can cause reduced success with fish spawning, swimming speeds, and feeding. These parameters should be measured during storage of drought waters and actions taken to minimize unfavorable conditions.

Inundation and drawdown can have a positive effect on the fisheries if the above parameters are not limiting. Inundation of soils covered with leaves and herbaceous vegetation can provide a source of food for benthic detritivores and microfauna as well as an important source of nutrients and substrate for algae and aquatic detritivores (Ploskey, 1981). The input of herbaceous vegetation could be significant considering the large area of scrub/shrub inhabiting the valley floor behind Knighville Dam and the amount of area to be inundated. Flooding of terrestrial areas with vegetation can also enhance the number and quality of sites available for spawning depending on the area inundated (Ploskey, 1983).

Predator fish can benefit from drawdowns in late summer and fall. Drawdowns force prey fish to leave the cover of inundated vegetation and also concentrates the prey fish, thereby increasing their availability to predators (Ploskey, 1981). This increases predator foraging and growth.

c. Project Operations. In order to create an emergency drought contingency pool at Knightville Dam, gate regulation would be necessary. All costs associated with gate adjustment for drought storage, removal of abnormal amounts of floating debris at the log boom and removal of any vegetation that dies as a result of long-term inundation would be the responsibility of the requestor.

d. Wetlands and Upland Vegetation

Non-open water wetlands of the Knightville Dam area are classified as palustrine according to the U.S. Fish and Wildlife Service, National Wetlands inventory. Classes and subclasses include: forested broad-leaved deciduous, forested needle-leaved evergreen, scrub-shrub and emergent vegetation.

There are 2,430 acres of Corps owned land at Knightville Dam, of which nine acres exist as wetlands. Seventy-seven acres of scrub/shrub cover the valley floor behind the dam. Willow (Salix spp.) is one of the most common species likely to be inhabiting this site.

Approximately 84% (2,051 acres) of the lands around Knightville Dam are forested. The most common and largest forest type is the sugar maple-beech-yellow birch (Acer saccharum - Fagus grandifolia - Betula lutea) northern hardwood type. This type covers over half of the forest area at Knightville Dam. Common associates include black cherry (Prunus serotina), white ash (Fraxinus americana), eastern hemlock (Tsuga canadensis), red oak (Quercus rubra) and white pine (Pinus strobus).

The second most common forest type is Hemlock. The predominant species is eastern hemlock, with beech, black birch (Betula lenta), and yellow birch.

Cover type along riverbanks, occurring in wet soils, is black ash - American elm - red maple (Fraxinus nigra - Ulmus americana - Acer rubrum). The demise of the American elm from the Dutch Elm disease has created a niche for the sycamore (Platanus accidentalis). The scrub/shrub noted along the riverbank is willow (Salix sp.).

Inundation of the terrestrial environment from flooding produces several changes in the soil chemistry. The major effect of flooding is the creation of an anaeorbic environment in the soil (Teskey, 1977). This results in an oxygen debt around the roots, carbon dioxide (CO_2) accumlation, and production of toxins (Whitlow, 1979). Species unable to tolerate these conditions will stop growth or cease to exist.

Flooding will have varying effects on species composition depending on the individual plant species tolerance to flooding. Red maple (Acer rubrum) is tolerant of deep flooding for one growing season, with significant mortality occuring if flooding is repeated the following year. Red oak (Quercus rubra), big tooth aspen (Populus grandidents), basswood (Tilia americana), American elm (Ulmus americana), hophornbean (Ostrya virginiana), and white ash (Fraxinus americana) are common species of trees at Knightville that are slightly tolerant of flooding. That is, able to survive flooding or saturated soils for 30 consecutive days during the growing season (Whitlow, 1979). A complete classification of wetlands and upland shrubs in the area is not available. However, by comparing the known flood tolerance of trees in the habitat to the associated shrubs and herbaceous vegetation, an estimate of species tolerance to flooding can be predicted. A large amount of trees are not expected to be impacted by infrequent emergency storage.

A 40 foot increase of reservoir waters for drought storage would impact species not currently experiencing prolonged periodic flooding.

Duration of flooding, flood frequency, time of year, water depth and siltation are critical in determining a plants response to changes in water level (Teskey, 1977).

Flooding will have the greatest impact on vegetation during the growing season and the least impact during dormancy. Seedlings and immature specimens are generally intolerant of inundation (Whitlow, 1979). Increased erosion and loss of topsoil can further reduce the quantity and quality of vegetation able to recolonize the flood zone.

Fluctuation of water releases from the dam, in connection with drought storage and drought conditions could alter or stress the riparian vegetation downstream. Timing and duration of drought storage would effect the amount of change observed below the dam.

e. Wildlife

The varied habitats of open bottomland and forested slopes support many different populations of wildlife species. Upland game species include woodcock (Philohela minor), ruffed grouse (Bonasa umbellus), cottontail rabbit (Sylvilagus floridanus), snowshoe hare (Lepus americanus), and gray squirrel (Sciurus carolinensis). Pheasants (Phasianus colchicus) are stocked by the Massachusetts Division of Fish and Wildlife for fall hunting. The pheasants may supplement natural populations.

Small mammals, songbirds, osprey, and ducks are also found in the area. Populations of beaver (Castor canadensis), red fox (Vulpes fulva), gray fox (Urocyon cinereoargenteus), coyotes (Canis latrans), turkey (Meleagris gallopavo), and occasionally black bear (Ursus americanus), are also present.

Waterfowl use of the area is relatively low. Small nesting populations of wood ducks and hooded mergansers have been observed at Knightville. Migrating waterfowl, black ducks, blue-winged teals, green-winged teals, and American mergansers use the Westfield River for feeding and nesting.

The large stands of mature hardwoods, scrub/shrub zone in the valley and the ecoture between the two communities provides habitat for a number of game and non-game species. The border between the fields and the woods provides forbs and grasses for wildlife such as whitetail deer.

The valley floor provides an abundant supply of seeds, insects, and cover for pheasants and other wildlife. Because of the valley floor's shape, storage of drought waters could significantly reduce the area available for food and cover. Species could move to adjacent areas but the total amount of open area would be reduced.

Waterfowl are dependent on wetlands as a feeding, resting, and breeding area. Other wildlife such as muskrats (Ondatra zibethicus), beaver (Castor canadensis), and racoons (Procyon lotor) make use of the plants and fauna of this stream environment. Storage of drought waters will impact these species dependent on this habitat.

f. Threatened and Endangered Species

According to the Fish and Wildlife Service, except for occasional transient species, no threatened or endangered species are known to exist in the project area.

g. Historical/Archaeological Resources

An Archaeological and Historical Resources Reconnaissance at Knightville Dam in 1982 identified 64 historic period sites in the project area. Forty-five of these sites lie below spillway crest elevation 610 feet. Five of these sites could be effected by a drought contingency storage to elevation 520 feet. Two of these sites are pre-1938 homes. There is a former cemetery, from which all of the graves have been previously removed, and a post-1938 concrete bridge erected by the COE. There is also a pre-1856 farmstead site which well preserved house and barn foundations which is probably eligible for the National Register of Historic Places.

No pre-historic sites have been found, however certain areas below elevation 520 feet, notable the terraces along the river, have a moderate site density probability, which are likely to contain a number of significant prehistoric sites.

A determination of eligibility for the National Register for the historic sites, and an archaeological evaluation of the areas of prehistoric site potential in order to comply with the requirements of the National Historic Preservation Act and the Archaeological Resources Protection Act has not been performed.

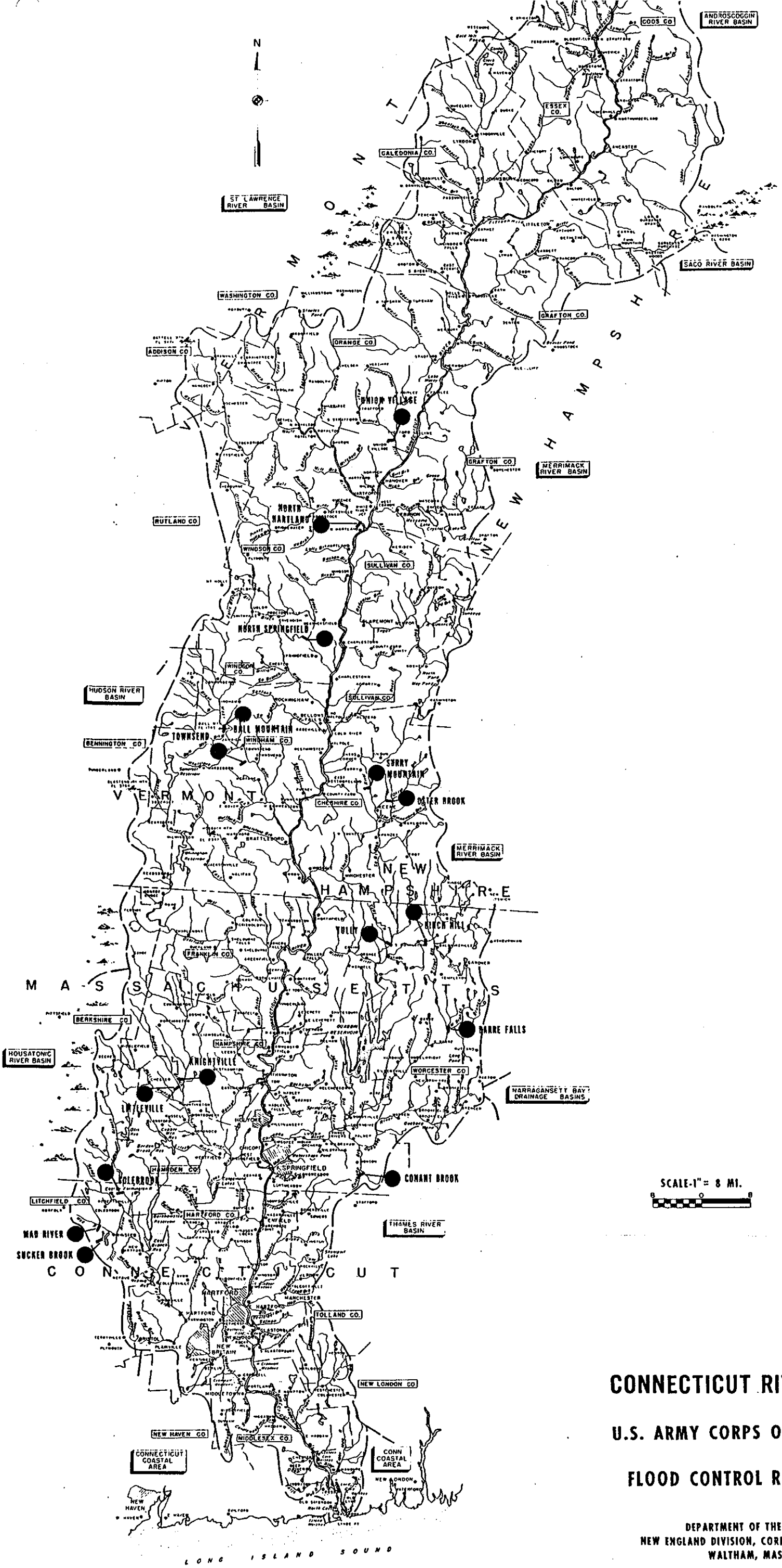
11. SUMMARY AND CONCLUSIONS

Knightville Dam is located on the Westfield River in central Massachusetts in a region where 13 public water supply systems service 174,000 people. In an emergency Knightville Dam could provide about 1975 AC-FT (643 MG) of seasonal water supply storage. Water quality at Knightville is good. Storing water at the project might slightly degrade the existing water quality, however with filtration and disinfection it would be acceptable for public water supply. A monitoring program should be implemented to measure levels of turbidity, coliform bacteria and heavy metals if the stored water is to be used as a public drinking water supply.

Drought contingency storage at Knightville during the growing season would impact existing vegetation on up to 145 acres in the reservoir area with accompanying impacts on non-water based recreation facilities and activities at the project.

Also, drought contingency storage and minimum releases at this normally "dry-bed" reservoir where inflow generally equals outflow, could produce added downstream environmental impacts. A review of all current applicable environmental, riparian or other laws would be required at the time of any decision to pursue drought contingency storage at Knightville Dam.

The Corps of Engineers would not consider drought storage activities at Knightville Dam without an official request from the Commonwealth of Massachusetts.



SCALE-1" = 8 MI.

8 0 8

CONNECTICUT RIVER BASIN

U.S. ARMY CORPS OF ENGINEERS

FLOOD CONTROL RESERVOIRS

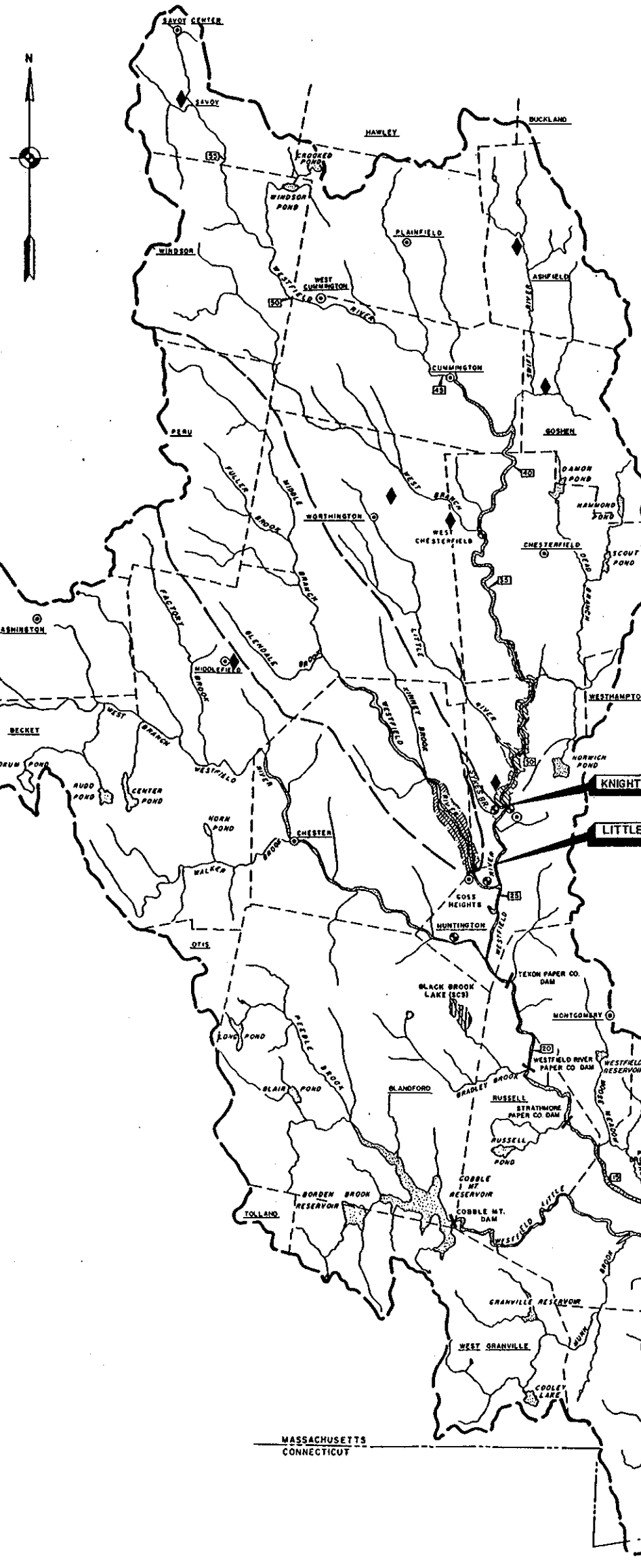
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

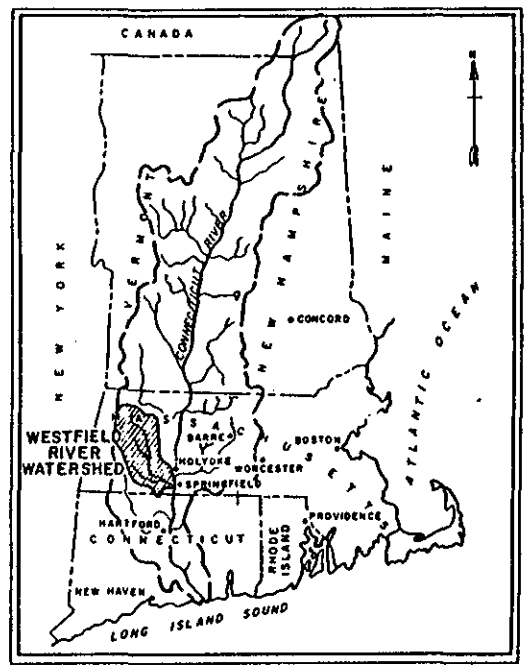
JANUARY 1981

PLATE I

CORPS OF ENGINEERS

U. S. ARMY





REGIONAL MAP

SCALE
10 0 10 20 30 40 50 MI.

WATER RESOURCES DEVELOPMENT PROJECT

WESTFIELD RIVER WATERSHED

WATERSHED MAP

NEW ENGLAND DIVISION, WALTHAM, MASS.

AUGUST 1977

PLATE 2

KNIGHTVILLE DAM
AREA AND CAPACITY

DRAINAGE AREA = 162 S.M.

Elev. (msl)	Stage (ft)	Area (acres)	Capacity Ac/Feet	Capacity Inches
480	0	0	0	0
490	10	12	73	.01
492	12	14	113	.01
494	14	16	153	.02
496	16	20	195	.02
498	18	25	244	.03
500	20	30	294	.03
502	22	36	384	.04
504	24	45	475	.06
506	26	55	592	.07
508	28	65	710	.08
510	30	75	872	.10
512	32	87	1035	.12
514	34	100	1235	.14
516	36	115	1435	.17
518	38	125	1705	.20
520	40	145	1975	.23
522	42	160	2317	.27
524	44	185	2660	.31
526	46	205	3045	.35
528	48	220	3430	.40
530	50	230	3857	.45
532	52	240	4285	.50
534	54	255	4802	.56
536	56	265	5320	.62
538	58	275	5892	.68
540	60	290	6466	.75
542	62	305	7072	.82
544	64	325	7680	.89
546	66	335	8350	.97
548	68	350	9020	1.04
550	70	370	9758	1.13
552	72	385	10497	1.22
554	74	400	11304	1.31
556	76	420	12113	1.40
558	78	435	12998	1.51
560	80	455	13865	1.61
562	82	470	14802	1.71
564	84	490	15740	1.82
566	86	510	16763	1.94
568	88	530	17787	2.06
570	90	545	18883	2.19
572	92	565	19980	2.31
574	94	585	21150	2.45
576	96	605	22320	2.58
578	98	625	23577	2.73
580	100	650	24836	2.88
582	102	670	26157	3.03
584	104	690	27480	3.18
586	106	715	28907	3.35
588	108	735	30335	3.51
590	110	755	31862	3.69
592	112	775	33390	3.87
594	114	795	34972	4.05
596	116	815	36555	4.23
598	118	835	38216	4.43
600	120	855	39880	4.62
602	122	875	41652	4.82
604	124	900	43425	5.03
606	126	920	45252	5.24
608	128	940	47080	5.45
610	130	960	49000	5.69

Crest Elevation = 610

PLATE 3

PERTINENT DATA
LITTLEVILLE LAKE

July 1977

LOCATION

Middle Branch Westfield River; Chester and Huntington, Mass.

DRAINAGE AREA

52.3 Square Miles

STORAGE USES

Flood Control, Water Supply

RESERVOIR STORAGE

	Elevation (ft msl)	Stage (ft)	Area (acres)	Acre-Feet	Inches on Drainage Area
Bottom of Water Supply Pool	432	0	0	0	0
Bottom of Flood Control Pool	518	81	275	9,400	3.4
Spillway Crest	576	144	510	23,000 (net)	8.3 (net)
Maximum Surcharge	591	159	584	31,200 (net)	11.2 (net)
Top of Dam	596	164	-	-	-

EMBANKMENT FEATURES

Type	Rolled rock and earth fill, rock slope protection, impervious core
Length (feet)	1,360
Top Width (feet)	25.0
Top Elevation (ft msl)	596
Maximum Height (feet)	164
Volume (cubic yards)	1,900,000
Dike	Left abutment - 935' long by 46' high

SPILLWAY

Location	Left abutment
Type	Ogee weir, chute spillway
Crest Length (feet)	400
Crest Elevation (msl)	576
Surcharge (feet above crest)	15

SPILLWAY DESIGN FLOOD

	Original Design
Peak Inflow (cfs)	98,000
Peak Outflow (cfs)	92,000
Volume Runoff (acre-feet)	62,500

OUTLET WORKS

Flood Control

Type	Horseshoe conduit
Tunnel Diameter (ft)	8
Tunnel Length (ft)	374
Gate Type	Electronically Operated Sluice
Gate Size	Two - 4' wide x 8' high
Invert Elevation (ft msl)	513(1)
Downstream Channel Capacity	1,500 cfs +
Discharge at Spillway Crest	2,270 cfs

(1) Discharge channel drops from 518 feet msl at weir (bottom of flood control pool) to 513 feet msl at the gate

Water Supply (City of Springfield, Mass.)

Type	Concrete conduit
Tunnel Diameter (ft)	4
Tunnel Length (ft)	800

Gates

Gate (No.)	Size ("in Diam.)	Type	Invert Elevation
1 (inlet)	36	Sluice	502.2
2 "	36	Sluice	483.8
3 "	36	Sluice	465.4
4 "	36	Sluice	447.0
5 (outlet)	48	Butterfly Valve	432.0
6 (drain)	46x48	Sluice	432.0
7 (mud gate)	12	Sluice	432.0

LAND ACQUISITION

Fee Elevation (ft msl)	581
Fee (acres)	1,567
Easement (acres)	10
Clearing Elevation (ft msl)	523

MAXIMUM POOL

Date	Mar 1977
Stage (feet)	120.6
Elevation (msl)	548.6
Percent Full	46

UNIT RUNOFF

One Inch Runoff: 2,790 acre-feet

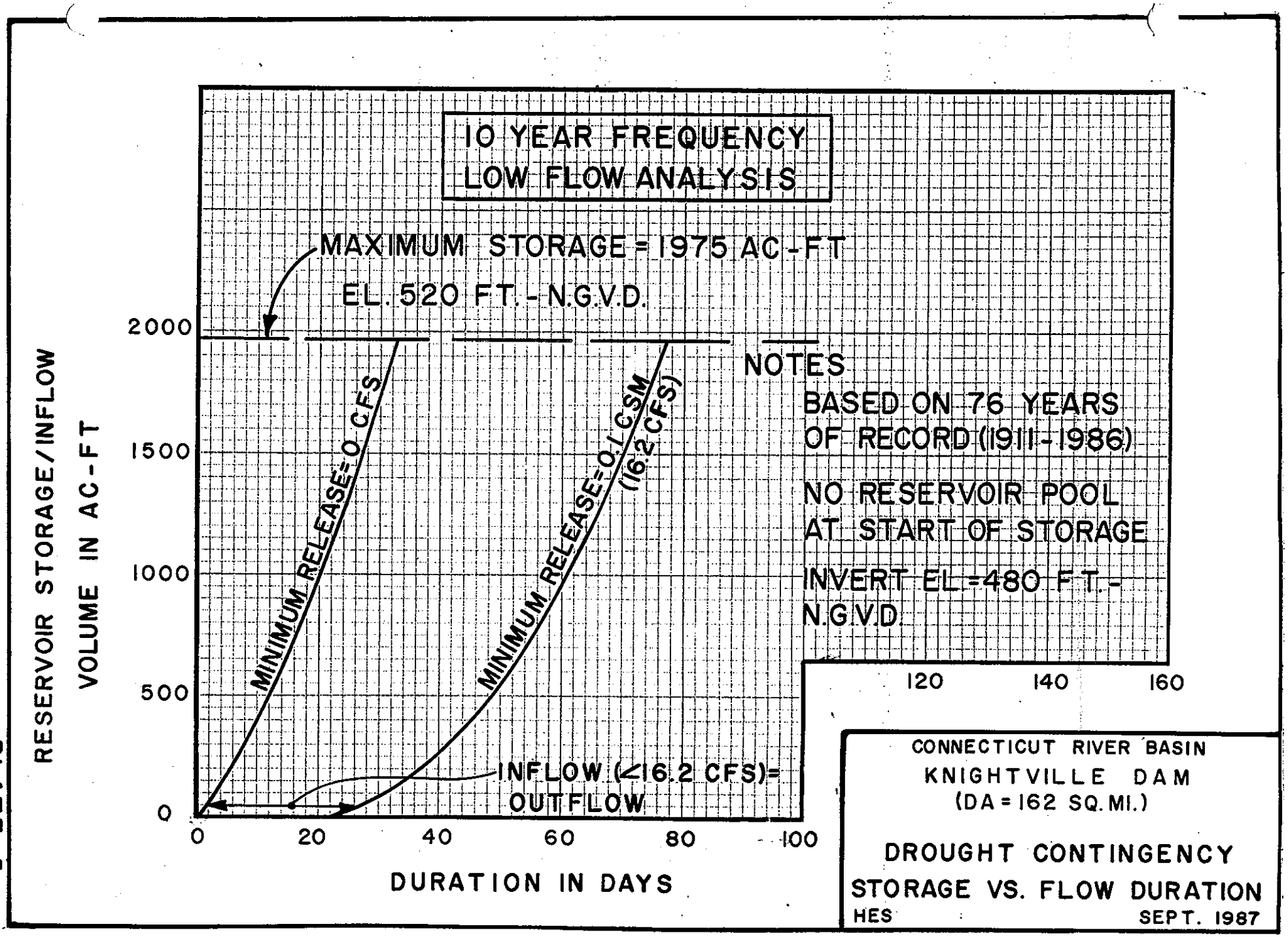
OPERATING TIME

Open/Close flood control gates: 5 feet/min

PROJECT COSTS (THROUGH FY 76): $7,013,000

DATE OF COMPLETION: October 1965

MAINTAINED BY: New England Division, Corps of Engineers


10 YEAR FREQUENCY
LOW FLOW ANALYSIS
MAXIMUM STORAGE = 1975 AC-FT
EL. 520 FT. - N.G.V.D.
2000
1500
1000
500
0
MINIMUM RELEASE=0 CFS
MINIMUM RELEASE=0.1 CSM
(16.2 CFS)
INFLOW (<16.2 CFS)=
OUTFLOW
0
20
40
60
80
100
120
140
160
DURATION IN DAYS
RESERVOIR STORAGE/INFLOW
VOLUME IN AC-FT
NOTES
BASED ON 76 YEARS
OF RECORD (1911-1986)
NO RESERVOIR POOL
AT START OF STORAGE
INVERT EL=480 FT.-
N.G.V.D.
CONNECTICUT RIVER BASIN
KNIGHTVILLE DAM
(DA = 162 SQ. MI.)
DROUGHT CONTINGENCY
STORAGE VS. FLOW DURATION
HES
SEPT. 1987
PLATE 5